THE SOURCE SELECTION EVALUATION DECISION SUPPORT SYSTEM

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A SOURCE SELECTION DECISION SUPPORT SYSTEM

Significant amounts of resources are allocated to Source Selection Evaluations within the Department of Defense. A typical source selection is divided into sub-components such as: technical criteria, management criteria, and cost. Source selections are completed for a variety of systems including, but not limited to, aircraft, missiles, ships, space systems, system level depot maintenance (public vs. private competitions), and computer equipment. Currently, the procedure for selecting the winner involves an assessment of all the criteria and sub-elements on which the contractors have been evaluated. Teams responsible for each sub-component brief the Source Selection Evaluation Board on the various results, and a winner is selected.

We have developed a prototype Decision Support System in Microsoft EXCEL that can be used to compile source selection information from the various teams (technical, management, cost, etc.) in order to make an objective selection based on the analysis of each of the criteria and sub-criteria. The Decision Support System utilizes a weighted evaluation mathematical model to compile various contractor scores for sub-criteria.

This Decision Support System demonstrates a methodology that can be used by management and analysts in completing source selections.

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I.   INTRODUCTION

The source selection process within the Department of Defense is one of the most time consuming activities for acquisition personnel. A source selection team typically consists of a technical team, management team and cost team. Team members are tasked with evaluating the competing contractor's proposals in their area of expertise (i.e. technical, management or cost).

Currently the evaluation method for competitions is to select one contractor for award on the basis of which proposal represents the best value to the Government. These proposals are evaluated using evaluation factors such as: Technical, Management, Cost, and Integrated Logistics Support. The evaluation factors vary in importance for each unique competition.

There are many complexities that exist in source selections: numerous contractors, various evaluation criteria, and different rankings for each of the evaluation criteria. Compiling the results of each team's evaluation into an understandable format to present to top management is a difficult process.

A Computer Based Decision Support System (DSS) may help to overcome several of the obstacles which currently exist in the evaluation of contractor bids. This paper presents a DSS which implements a weighted evaluation model (the Brown-Gibson model) in order to summarize source selection information.

The objective of the DSS is to provide an automated system that can function as a tool to aid decision makers in the evaluation of source selections, and to provide a tool which visually assists the evaluation team in summarizing the subjective and objective attributes of the competition.

II.   THE SOURCE SELECTION DECISION SUPPORT SYSTEM

This Decision Support System summarizes source selection information by generating a spreadsheet that is created using macros and various user inputs. Information from the technical, management and cost teams is used to calculate an overall score for each contractor participating in the source selection. Much of the information that is entered into the spreadsheet comes from the Request for Proposal (RFP). Each RFP contains guidelines on how the contractors will be evaluated. As mentioned in the introduction, the most common evaluation criteria are technical, management and cost. Also included

in the RFP are sub-elements for each of the main criteria. For example, there may be 5 sub-elements which are analyzed for the technical criteria, and 3 sub-elements for the management criteria. This information from the RFP is necessary in order to complete a "session" using the Source Selection DSS.

The DSS is built using Microsoft Excel 4.0, and is designed to run on a 386 based IBM compatible computer with a hard disk drive and color monitor. The DSS is designed for someone familiar with DoD and the basic concepts involved in conducting a source selection, however, even an inexperienced user can manipulate the model. Currently, the DSS can accommodate up to 12 companies in a source selection.

III.   WHAT IS A COMPUTER BASED DECISION SUPPORT SYSTEM ?

A Computer Based Decision Support System is a computer driven system designed to aid managers in making decisions. Some of the major characteristics of a DSS are: fast response, ability to conduct sensitivity analyses, objective decision making, and facilitated communication. There are three basic components in a DSS:

- Dialog Base
- Model Base
- Data Base

Each of the above elements and how they relate to the Source Selection DSS will be described in more detail.

A. DIALOG BASE COMPONENT

The dialog base component of the DSS consists of macros, buttons and dialog boxes written in Microsoft Excel. Each of these features provides the DSS user with a comfortable environment that allows interaction and real-time response. The screens are designed to be clear and concise, and the user is allowed to move around by clicking on buttons that are available on each screen. There are buttons to move forward, return to the previous screen, or to access help menus.

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Macros are lines of software code which are instructions that tell the computer to invoke certain operations. At their best, macros can do in minutes what might take hours to do with standard worksheets and processes. An example of one macro used in this DSS is: a macro builds a spreadsheet that the user then enters data into.

The dialog base is the guiding force behind the model base and the database. More importantly, it is the interface with the user, so it must be easy to use and understand. Excel offers several ways to request information from users. The dialog base uses the option of creating a dialog box. Excel returns the information a user enters into the dialog box to the macro sheet that brought the dialog box up on the screen. The dialog box allows the user to easily enter their source selection inputs into the DSS. This is accomplished by prompting the user with questions and stepping them through the process of entering the information required to build the competition spreadsheet.

B. MODEL BASE COMPONENT

The model base component of this DSS consists of a model called the Brown-Gibson Model, which is a model used to conduct a weighted evaluation for objective and subjective measurements. It was mentioned earlier in the report that the goal of the DSS is to assist top management within the Department of Defense in making decisions during the source selection process. The Brown-Gibson Model combines the objective and subjective measures from the source selection evaluation and calculates a numeric score for each alternative. These numeric scores can then be analyzed to determine which alternative should be selected.

The Brown-Gibson Model is used to summarize the technical and management (subjective) criteria and the cost (objective) criteria. The Brown-Gibson Model can be summarized in a mathematical expression:

Weighted
Evaluation = $(WT_1)(SM_1) + (WT_2)(SM_2) + (WT_3)(OM_1)$

Where:

WT_n = the weight, or importance, of each individual criteria, i.e., cost, technical, and management

SM_n = the subjective measure of criteria n

OM_n = the objective measure of criteria n

This formula can be extended for as many subjective elements as there are in the source selection. It was mentioned in the introduction that many source selections are evaluated on cost, technical and management criteria. Therefore, these are the criteria that were used in the examples.

1. Subjective Measures

Determining the subjective measure for each alternative involves transforming the nominal ratings into numerical scores. Then each individual attribute within a subjective category is assigned a weighting. (NOTE: These weightings must sum to 1).

The calculation of the subjective measure for each alternative is as follows:

$$SM_n = \sum_{n=1}^{N} (\text{subjective attribute weight}) * \frac{\underline{\text{subjective evaluation rating}_{ni}}}{\sum_{\text{all } i} \text{subjective evaluation rating}_i}$$

The subjective attribute weight is the relative importance for each of the criteria within this particular subjective category. The evaluation ratings are the nominal point values which were determined by the source selection team as to how a company should be rated. The most common rankings for source selections consist of 5 possibilities:

- outstanding (5)
- highly satisfactory (4)
- satisfactory (3)
- marginal (2)
- unsatisfactory (1)

An example will be presented next in an effort to clarify the model calculations.

This example presents a situation in which three companies are evaluated on the basis of the technical criteria. The management criteria would be evaluated in a similar fashion. It was mentioned earlier in the paper that there are often sub-elements within an evaluation criterion. The example below shows 5 sub-elements under the technical attribute. These items would be specified in the RFP. For this example, equal weights were assumed for each sub-element. The values shown for each company represent an example of how the technical team could rate each company for each sub-element, where the values of 1-5 correspond to the rankings listed above.

Technical Subjective Attribute	Weight	Company 1	Company 2	Company 3	Sum
Production	0.20	5	3	3	11
Quality	0.20	2	4	5	11
Facilities	0.20	1	3	3	7
Safety	0.20	4	4	4	12
Engineering	0.20	2	5	3	10

$$1.00 \quad SM_1 = 0.2625 \quad SM_2 = \text{▓▓▓▓▓▓▓} \quad SM_3 = 0.3578$$

The subjective measures (SM_1 through SM_3) were calculated using the formula for SM_n shown above. The calculations for SM_1 are included next as an example:

$$SM_1 = (.2)(5/11) + (.2)(2/11) + (.2)(1/7) + (.2)(4/12) + (.2)(2/10)$$

$$= .2625$$

The subjective measures for Company 2 and Company 3 were also calculated using the same formula.

The subjective portion of the model base interacts with both the dialog base and the database of the DSS. The user is initially asked a series of

questions, and the responses are stored to be used in the calculation section of the Brown Gibson Model. The user is asked to input what subjective criteria are being evaluated, the weightings for the criteria and the actual nominal scores. This information is then saved into the database for future use.

The above table demonstrates some of the calculations which are completed in the model. The table above would be built by macros as a result of the user inputting information into dialog boxes.

2. Objective Measures

Determining the objective measure (OM) for each alternative involves transforming the cost into a relative score between 0 and 1, so that the sum for all alternatives is 1.0. The methodology that is used to transform the costs into values between 0 and 1 is presented in the equations below:

$$OM_n = 1/(Cost_n * S)$$

$$S = \sum_{n=1}^{N} 1/Cost_n$$

An example of how the OM_n is calculated is shown in the table below. The formulas for both subjective and objective measures are incorporated into the cost section of the DSS, so the user does not need to know all of the details to use the system. However, for explanation purposes, a basic knowledge of how the objective measures are calculated is important for the user to understand.

ALTERNATIVE	COST
Company 1	$130,000
Company 2	$150,000
Company 3	$165,000

$$S = 1/130,000 + 1/150,000 + 1/165,000$$
$$= .000020418$$

$$OM_1 = 1/(130{,}000 * .000020418)$$
$$= .377$$
$$OM_2 = 1/(150{,}000 * .000020418)$$
$$= .326$$
$$OM_3 = 1/(165{,}000 * .000020148)$$
$$= .297$$

As a check, the objective measures should sum to 1.0: $.377 + .326 + .297 = 1.0$

The costs above are the result of the cost team developing an independent estimate based on each company's proposal. The highest score goes to the company with the lowest cost. This is due to the fact that low cost is often a criterion. However, cost is not the only criterion to consider. Therefore, there is a need to tabulate the cost results into decimal format, so that the other evaluation criteria can also be factored in.

3.   Combining the Measures

Once the objective and subjective measures for each company are calculated within the categories, the overall scores for the companies are calculated by applying the same basic principles. The user must determine how the various categories should be weighted (i.e. how the categories are ranked between: technical, management, and cost, etc.). They can all have an equal weight, or different weights can be assigned based on the importance of the criterion. It is important to keep in mind that all weights must add up to 1.0. Guidance for the weights can be found in the RFP. Typical RFPs will not explicitly state weighting factors, but rather will indicate a ranking from highest to lowest for the various criteria. An example of wording from the RFP is: "Technical is the most important criterion, cost is the second most important criterion and management is the least important criterion, with management being half as important as cost". From this statement, weightings can be assigned for each of the criteria. For illustration purposes, it was assumed that only one subjective measure, technical, and one objective measure, cost, were used for the example evaluation presented below.

Category	Weight	Company 1	Company 2	Company 3
Cost	0.50	0.3770	0.3260	0.2970
Technical	0.50	0.2625	0.3797	0.3578
	1.00	0.3198	▓▓▓▓▓▓	0.3274

Based on the above calculations, company 2 would be selected as the overall winner in the competition, even though they would not be selected if cost were the only evaluation factor.

C. DATA BASE COMPONENT

The data base component of the Source Selection DSS is built around the concept that the key information required when running this program is the most recent evaluation data available. For this reason, there is no need to bring in any historical tables, nor do we need to sort through prior competitions to assign a value to the subjective criteria.

The Source Selection DSS incorporates a function for either a new or an existing competition. If the competition is new, the user is led through a process of queries in order that a new spreadsheet can be assembled. If, however, the user wishes to run a previous competition, then it is necessary only to type in the file name and that competition is restored from the data base. The existing files may be edited with new information or the user can conduct sensitivity analyses with a range of data. For new users the existing file feature is an excellent tool for familiarizing themselves with the various aspects of the Source Selection DSS. At any time during the session, the user may select the help function by clicking on the help button. The help buttons can be used as a guide for rankings or for more knowledge about the Brown-Gibson calculations. The user is then free to scroll throughout the help function and learn about the criteria employed.

IV. POSSIBLE IMPLEMENTATION PROBLEMS/ISSUES

One potential difficulty in implementing this model will be gaining top management support for the model to be used as a decision tool. Currently, the source selection decision process is often completed by the senior management within the command. One of the goals in developing this model was to create a

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decision tool that would make the process of choosing a winner in a source selection a more "scientific" process. In the current system, the Source Selection Advisory Council is provided a briefing on each of the areas being evaluated, for example: technical, management and cost. The technical and management briefings (subjective areas) list the companies and the results of the ranking process as outstanding, highly satisfactory, satisfactory, marginal, and unsatisfactory. A cost briefing is also given, which provides an objective measure. Once all of the briefs have been presented, top management must make a decision. Without a system that summarizes the information in an objective manner, decisions may tend to be more subjective.

This model is not intended to replace top n.anagement's decision authority. There is an inherent weakness with the inputs of the model because two of the factors are subjective. Hence all subjectivity is not eliminated. The need for top management to determine close decisions for the best value of the government still exists. The Source Selection Model is designed primarily to be used as a tool in summarizing all of the information collected and analyzed during a source selection.

V.   SUMMARY

This model demonstrates the useful qualities of a Decision Support System and its applicability to the source selection environment. Although this model will not eliminate all of the subjectivity associated with source selections, it does require that scores and weightings be tabulated for each sub-element in the evaluation. This may help the participants in a source selection put everything in perspective.